

Palatability Factors: Identification and Control

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Introduction

Palatability is a concept with which we all have some familiarity. As individuals, we are impacted by it, to a certain degree, each time we have the opportunity to consume a food or drink. As providers of animal nutrition products, we know that no matter how good our product may be nutritionally, it has to be consumed by our animal clients to be of benefit.

In its simplest form, a “palatable” food is one that is sufficiently acceptable to an animal that it is eaten. From this basic objective, the concept of palatability can extend from the view of food intake as a means of sustenance to that where the interaction with one's food is associated with extreme pleasure.

When it comes to the feeding of man's animals, we can also find a similar range of situations. In animal production, the food must have enough palatability so that enough is consumed to support maximum production. Matching an animal's genetic potential for production with the appropriate intake of nutrients through the feed is critical to maximizing profit. When feed intake is not consistently optimized inefficiency results.

When feeding our pets, however, many humans derive pleasure from the perception that their pets are truly “enjoying” the food they have been offered. Due to the inherent language barrier, the way this is typically evaluated is through the observation of how a

pet interacts with its food. If a pet truly enjoys its food, the reasoning goes, it will eagerly anticipate it being offered and vigorously consume all that is provided. If a pet appears to enjoy its food, it is thought to be good for the pet. If a pet does not appear to be extremely interested in its food, the thought is that the food is not so good. Subsequent buying decisions can be heavily influenced by such observations.

The pursuit of palatability enhancing materials has been a major human quest since before the beginning of recorded history. Spices, which are aromatic flavorings made from plant parts, have caused different cultures to interact through trade, and sometimes driven them to even war. Even in today's animal feed industry, battle lines are sometimes drawn around the concept of whose products are more palatable.

Our concept of palatability in animal feeds is based upon human observations and interpretations of animal behavior. Many factors are probably involved in an animal's perception of what constitutes a palatable food. An animal's palatability response represents an integration of information received from its various senses, and its interpretation in the context of an animal's innate and learned experience. Before we can begin to impact palatability, we must first appreciate the many factors involved and how they interact. Palatability is best understood by taking a system approach.

In the evaluation of a complex system, it is important to first understand its purpose. Then, its various components can be identified and studied in the context of how they serve the purpose. Once these are better understood, we can better exercise control. This is the approach taken relative to the following presentation.

While there is much that could be said about this topic, our time constraints allow for only a brief, general overview. Therefore, this presentation merely hopes to introduce some of the major considerations involved and briefly illustrate how one might begin to go about using them in the context of animal feeds.

Palatability : What is its Purpose?

Animals receive information about their environment through their various senses. The 5 classical senses are hearing, sight, smell touch and taste. A major role for the senses is to enable an animal to safely interact with its environment. Stimuli from the various senses are evaluated by the central nervous system. An appropriate behavioral response results. This response, to varying degrees, is heavily influenced by experience.

The above system allows an animal to both learn from and safely interact with its environment. Thus it is important to an animals well being and ultimately its survival.

The “palatability response” is an important survival tool. It represents a system for protecting an animal from consuming materials, as part of its food, which may be harmful to it. Conversely, it encourages an animal to consume foods that experience indicates to be beneficial.

Palatability Profile : The combination of a food’s sensory stimulating characteristics is what an animal uses to evaluate a food’s suitability for consumption. For the purposes of this article, we will refer to this as a food’s “*Palatability Profile*” .

The Important Role of Experience and Age :

Palatability is heavily dependent upon experience, both innate and learned. This is an extremely important point relative to its evaluation and control. A previous bad experience associated with a given set of palatability factors results in an animal being averse to food displaying these factors. This can be the case even when the food currently being offered is good.

Many of us can relate to this type of situation based upon our own experience. Some of us have had experiences where a once favored food has been associated, for whatever reason, with gastric upset. The result is that we become wary of this food,

until that time that we have re-learned to trust it.

Similar situations occur with animals. Experience, or past history, helps to explain why certain palatability systems work in some cases, but not others.

As an animal ages, two things occur which may impact its perception of a food's palatability. One is that an older animal will have had a greater opportunity to be exposed to different situations. Therefore, it will have more "experience" upon which to base its interpretation of and response to sensory stimuli. Another is that as an animal ages, its taste preferences tend to change or "mature". Therefore, a Palatability Profile favored by a young animal may be considerably less acceptable to an older animal. Conversely, that favored by an older animal may not be acceptable to a younger animal.

Animal Senses and their Role in the Palatability Response :

While the senses of smell and taste are typically most closely linked with the palatability response, all of an animal's senses can play a role.

Sound : We all know that through experience, certain sounds, such as a dinner bell, can initiate our drive to consume food. Other sounds such as those which trigger anxiety or fear, can repress the desire to eat.

Sight : Food with an unfamiliar appearance will typically trigger caution and an associated wariness relative to its consumption. Food, with an appearance with which an animal is familiar does not have to be as closely investigated.

Touch : The sense of touch or feel must also be satisfied. An animal will typically probe or play with an unfamiliar food prior to its consumption. Mouth "feel" is another evaluation criteria relative to an animal's palatability response. Once in animal's mouth,

the physical characteristics of a food, such as its degree of hardness, texture, etc. are evaluated and factored into an animal's response to it.

Smell : The odor of a food is an especially important factor in the palatability response of many animal species. Specialized nerve cells located in the nose are responsible for the sense of smell. The sense of smell also has a great influence upon the perception of taste. This is a critical point to remember when designing a food's Palatability Profile.

The sensation of smell is associated with volatile compounds given off by a food. Such compounds must "leave" the food, go into the air that surrounds it, and then enter the animal's nose to have an effect. Once all of an odor-producing chemical has left the food, it will no longer have this odor component associated with it. Therefore, the odor of a food can diminish and change over a period of time. This is an especially important issue when trying to manipulate the odor of a food through the use of Palatability Enhancers.

The number of different types of odor inducing molecules associated with a food and their respective level of concentration at a given point in time determines the odor profile of a food.

Taste : Whereas smell is associated with the nose, taste is associated with the mouth. Specialized nervous system structures, called taste buds, are the receptors for taste inducing stimuli. Stimulation of these receptors requires that substances be dissolved. This can be an important consideration relative to how a flavor-enhancing compound is packaged in the context of a finished feed. If such a material can not become dissolved while the food is in an animal's mouth, its palatability enhancing potential will be lost.

Taste is typically divided into four primary types ; sweet, sour, salty and bitter. A food's taste results from an interaction of the relative concentrations of molecules contributing to each of these four taste categories. In addition, as previously mentioned, the sensation of taste is heavily influenced by a food's odor profile.

Control

The animal foods we create must simultaneously be nutritious, wholesome, economical and well received by the animal. Each of these needs, of which palatability is just one, have its own set of dynamics that must be factored into the final food. Interactions between these major factors must also be considered

Any aspect of a food, which impacts an animals sensory system, can have an impact upon an animal's perception of a food and thus the food's palatability. Due to the many contributing factors, palatability must be viewed in the context of the overall food system. Therefore, attempts to control palatability must take into consideration a variety of factors, several of which are discussed below.

Quality Considerations

Wholesomeness of the food :

As animal food manufacturers and providers, the health and well being of the animals we feed is of primary concern. Therefore, the foods we prepare and offer to our animals must be wholesome. While we may be able to design palatability enhancement systems that can “trick” an animal into consuming an unwholesome food, the wisdom of doing so must be questioned.

An unwholesome food is one that has a negative impact on animal health and/or performance. Whenever animal health or performance is compromised, both the customer

and supplier of the food are harmed. In addition, if the food results in some form of illness, the animal will eventually learn to associate the products Palatability Profile with a negative experience. When it is exposed to the Palatability Profile in the future, its response will probably be negative.

Therefore, the foods we manufacture and provide must be wholesome. As a result, an important place to start is with the ingredients used to manufacture a food. As we all know, the quality of a finished feed is heavily influenced by the quality of the ingredients used in its manufacture. In addition, the handling, processing and storage of the food must insure that the wholesomeness of a food is maintained. Manufacture of a wholesome food is not enough. Of primary importance is its wholesomeness at the time it is offered to the animal.

Therefore, a systems approach to palatability requires that careful attention be given to all aspects of quality associated with the manufacture and storage of a food product. Two areas of quality, which require particular attention relative to the practical manufacture of animal foods, are the prevention of mold and the preservation of fat quality.

Mold : Mold is a constant threat to the quality of food. Mold growth does not necessarily have to be visible to have an impact on animal health and performance.

As mold growth occurs, not only are nutrients in the feed consumed. Various products of mold growth can have a negative impact on the Palatability Profile of the feed. In addition, as we are all aware, mold generated mycotoxins can very detrimental to health.

While the control of moisture level in the feed is the best tool for controlling mold growth, the use of mold inhibitors should also be considered in certain situations. Such situations include those where a finished product may be exposed to high humidity, changes in environmental temperature as well as when there is the need for a prolonged

shelf life.

Rancification of Fat : The rancification of fat is a natural decomposition process that has both health and palatability implications. Since fat is an important contributor to the Palatability Profile of a food, the maintenance of fat quality is critical.

The most important control points are the initial quality of the fat used, the maintenance of quality during storage, how the fat is incorporated into the product during manufacture and the “shelf” environment to which the fat within the finished product is exposed. In addition to these process management considerations, the use of appropriately designed antioxidant systems is recommended. This is especially true when the food contains a large proportion of fat, such as is the case with many pet foods, as well as when extended shelf life requirements are involved.

Product Formulation and Manufacturing Considerations :

Product Formulation : The ingredients used in a food have a major impact on its resultant Palatability Profile. Of importance here are the characteristics of each individual ingredient, their level of usage and how the individual Palatability Profile of each ingredient interacts in the context of the final product. Therefore, product formulation, and changes to it, are important control points.

In today’s competitive, cost driven marketplace, economics often result in the use of ingredients that would not normally be part of an animal’s “natural” diet. While animals can often be “trained” to accept such ingredients, their proper packaging in the context of a product can greatly enhance the rate and extent of acceptance.

Least cost formulation enables nutritionists to achieve targeted levels of nutrients in a finished feed through the lowest cost combination of ingredients. When least cost formulation causes wide fluctuations in the types and levels of ingredients used over a

period of time, associated changes in the Palatability Profile of the food can result. Such changes can result in an animal not recognizing a “new” batch of feed and cutting back on feed consumption. While such responses are usually transitory, these fluctuations in feed consumption are damaging to an animal's productive performance. In addition they create a negative perception, on the part of the human purchaser, regarding the quality of the product.

Ingredient Variation : In addition to intended formulation changes, differences from lot to lot of an ingredient can also impact the Palatability Profile of a formulation that has otherwise not changed. While all ingredients are subject to some variation, previously processed grain and animal by-products are especially susceptible to such variation.

Product Form and Physical Characteristics : As previously discussed, the physical characteristics of a feed are also a part of the Palatability Profile “puzzle”. Identifying the optimum physical characteristics for a food, such as shape, size, texture, etc., is another important consideration.

All manufactured feeds undergo some degree of processing. Maintaining the consistency of the processes involved in the manufacture of a food is critical to being able to offer a product that appears similar in physical characteristics over a period of time.

Achieving and maintaining a specified level of palatability thus has two major “Quality” components. One is the optimization of ingredient usage in the context of a given set of manufacturing processes. The second is the maintenance of perceived consistency.

Palatability “Enhancers” : Palatability Enhancers are added to a food to encourage its consumption. They can be used to both improve the Palatability Profile of a feed

while also providing for the maintenance of perceived consistency. This is particularly important in situations where fluctuations in ingredient usage an/or quality are a factor. In this way, they can help to insure that a good food is perceived as such by an animal and consistently consumed.

Palatability Enhancers may also be used in situations where we are trying to encourage an animal to eat a food which may not taste good, but which is designed to provide it with considerable benefit. Examples of such a situation include those where an unpalatable but otherwise beneficial medication or other feed additive is included in the feed to enhance the health status of an animal.

For purposes of our discussion, we will first split Palatability Enhancers into two primary categories, Nutritive and Non-Nutritive. Nutritive Palatability Enhancers are those ingredients which have nutritional value but may be used at levels greater than what nutritional need dictates due to their contribution to a foods Palatability Profile. Two examples of nutritive Palatability Enhancers are salt and added animal fat.

Non-nutritive Palatability Enhancers are added solely for their ability to appeal to an animal's senses. They make no significant contribution to the nutritional profile of a feed. Typically, they are designed to appeal to the senses of smell and taste.

Design : While some single ingredient Palatability Enhancers exist, most involve a combination of materials designed to mimic the aroma/flavor profile of a food that is typically preferred by a given type of animal. Since most natural aromas and flavors are complex combinations of chemicals, attempts to mimic them will typically require that a combination of materials be used. (Note: One of the beauties of nature is its complexity. It is this authors opinion that the more complex aroma/flavor profiles tend to also be the most interesting and thus appealing.)

Achieving the proper balance between aroma and flavor notes is another consideration. As previously discussed, aroma can have a strong impact upon the

perception of taste. This interaction must always be considered in the context of the type of animal for which a Palatability Enhancer system has been designed and its typical feeding behavior. Two examples are provided below:

Dogs typically rely heavily upon the aroma of a food, as part of their evaluation of it. If the aroma and other physical characteristics are acceptable, they will often “gulp” the food down, with the food spending a relatively short period of time in the mouth. Therefore, achieving the proper aroma notes is critical.

Cats, on the other hand, tend to keep their food within their mouth for a relatively longer period of time. Therefore, taste, as well as other physical characteristics of the food contributing to its “mouth-feel” is much more important in a cat food.

Palatability Enhancers work best when they build-upon and compliment the palatability characteristics inherent to a given food formulation. Therefore, in addition to considering the animal that is being fed, an assessment of the Palatability Profile of the range of formulations to which the Palatability Enhancer might be used must be made. This information must also be factored into the design of the Palatability Enhancer to be used.

Level of usage is critical. Many of the components used in Palatability Enhancers have a positive effect at very low levels. Use too little, and the benefit may be lost. However, this is **not** necessarily a case where if a little is good, more is better. As the levels of some components increase, they can actually begin to reduce palatability. Therefore, the proper balance between different components of a Palatability Enhancer must be achieved. In addition, the optimum usage level in the finished feed product must be determined and factored into its use.

Stability of a Palatability Enhancer is another important consideration. Of particular concern are aromas, which exert their palatability effect when they are volatilized into the air so that they can be smelled by an animal. If the aroma compounds are volatilized prior to the animal being able to experience them, they have no value. This

can be of particular concern when a Palatability Enducing Aroma is exposed to high temperatures during the processing of a feed or storage.

Apart from the outright loss of Palatability Enhancing components through volatilization, the extent to which added Palatability Enhancer components may react with other feed ingredients, in the context of a feed manufacturing process, must also be considered. Such reactions can have a negative effect, such as when the reaction products have no or possibly even negative palatability effects.

However, reactions within the food, in the context of added ingredients and a given manufacturing process, can also be used to benefit the Palatability Profile of a product. "Reaction" Flavors are those which result from an intended reaction of components, intentionally added to a formulation, during the manufacturing process. An example of this is when certain added amino acids react with added reducing sugars during a manufacturing process.

Application : Creating the best Palatability Profile for a given feed is thus a complex process if one has to start from the beginning. Fortunately, there are companies, which have considerable experience in this area and are able to help. Some questions to address in the early part of the development process are:

1. **Palatability Objectives** : What are the expectations relative to a food's palatability and how are they to be defined and then evaluated. How much cost can be added to a product to achieve the desired level of palatability.
2. **Type of Animal to be Fed** : To what type of animal will the feed be fed. Species, age, past feeding history, etc.
3. **Feed Formulation Issues** : Ingredients used, typical ranges of usage, extent of anticipated changes, etc.
4. **Processing Employed** : What types of processes will be employed during feed manufacture. Where will Palatability Enhancer(s) be added to the process and

how?

5. **Packaging, Handling and Required Shelf Life Requirements** : These are issues that must be addressed relative to the post-manufacture stability requirements of a food.
6. **Anticipated Human Customer Evaluation of Animal Feed** : How will the humans (i.e. livestock feeders or pet owners) involved evaluate the feed. Aroma? Appearance? Animal Response? Etc.
7. **“In-House” Ability to Consistently Meet Requirements** : Does your company have the equipment and manufacturing procedures required? What changes, if any, will be necessary?
8. **Flavor Supplier** : Who is your bet “partner” for supplying the required services and product. Factors to consider are experience, reputation, consistency of products, price etc.?

Summary

Many factors impact the palatability of a food. All must be taken into account when evaluating and trying to better control how an animal responds to your food product. Due to the complexity involved, attempts to control palatability require a systems approach.

In today's competitive animal food market, a food's palatability can be an important competitive factor. However, improving and maintaining the palatability of an animal food requires that many things be done well. Therefore an informed, integrated and disciplined approach is required. Fortunately, help is available through experienced flavor companies that can work with you for the attainment of your palatability goals.

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